
Scientific Exploration in Venezuelan Amazonas

Author(s): M. J. Eden

Source: *The Geographical Journal*, Vol. 137, No. 2 (Jun., 1971), pp. 149-156

Published by: geographicalj

Stable URL: <http://www.jstor.org/stable/1796735>

Accessed: 25-06-2016 23:47 UTC

REFERENCES

Linked references are available on JSTOR for this article:

http://www.jstor.org/stable/1796735?seq=1&cid=pdf-reference#references_tab_contents

You may need to log in to JSTOR to access the linked references.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at

<http://about.jstor.org/terms>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



The Royal Geographical Society (with the Institute of British Geographers), Wiley are collaborating with JSTOR to digitize, preserve and extend access to *The Geographical Journal*

The GEOGRAPHICAL JOURNAL

Vol 137 Part 2

June 1971

SCIENTIFIC EXPLORATION IN VENEZUELAN AMAZONAS

M. J. EDEN

During April–May 1968, the *Geographical Magazine* Hovercraft Expedition to Amazonas travelled from Manaus, Brazil, by way of the Rio Negro and Casiquiare canal into the Orinoco basin. Field studies relating to hydrological, ecological, agricultural and ethnobotanical problems were undertaken in the upper Orinoco region, from base camps at Esmeralda, Santa Barbara and Las Carmelitas. Subsequently, the expedition travelled down the Rio Orinoco, passing the Atures and Maipures rapids, and made the sea journey to the island destination of Trinidad.

DURING April–May 1968, an expedition under the patronage of HRH the Duke of Edinburgh, and sponsored by the *Geographical Magazine*, visited the upper Orinoco region of Venezuela. The party travelled by SR.N6 hovercraft and over a period of four weeks covered more than 3500 km through northern Brazil and Venezuela. The expedition commenced at Manaus, Brazil, and travelled north-westwards up the Rio Negro to its headwater region, thence crossing into the Orinoco basin by way of the Casiquiare canal. Excursions were made into a number of Orinoco tributaries, after which the expedition followed the Rio Orinoco downstream to its mouth and made the sea journey to the island destination of Trinidad. Approximately two weeks were spent in the upper Orinoco region, making scientific studies from base camps at Esmeralda, Santa Barbara and Las Carmelitas (Fig. 1).

As indicated, the route from the Rio Negro to the Rio Orinoco followed the Casiquiare canal, which is a natural waterway linking the two basins. This unusual stream, which is a tributary of the Rio Negro, crosses the watershed separating the basins at approximately 115 m above sea level; it flows in a south-westward direction, and owes its existence to having achieved partial capture of the Orinoco headwaters. Below the Casiquiare zone, the waters of the Orinoco and Negro rivers flow eventually to the Atlantic ocean, but *en route* their passage is many times interrupted by rapids. These have long hindered access to the interior region, especially the São Gabriel rapids at Uaupés on the Rio Negro and the Atures and Maipures rapids near Puerto Ayacucho on the Rio Orinoco.

The work of the expedition was concentrated in the upper Orinoco region, and had three principal objectives: firstly, it was intended to demonstrate the ability of the hovercraft to operate effectively in a remote tropical environment and along rivers intermittently obstructed by rapids; secondly, a programme of scientific investigation was to be undertaken; and thirdly, a television film and journalistic

➔ Michael J. Eden is lecturer in geography at Bedford College, London University.

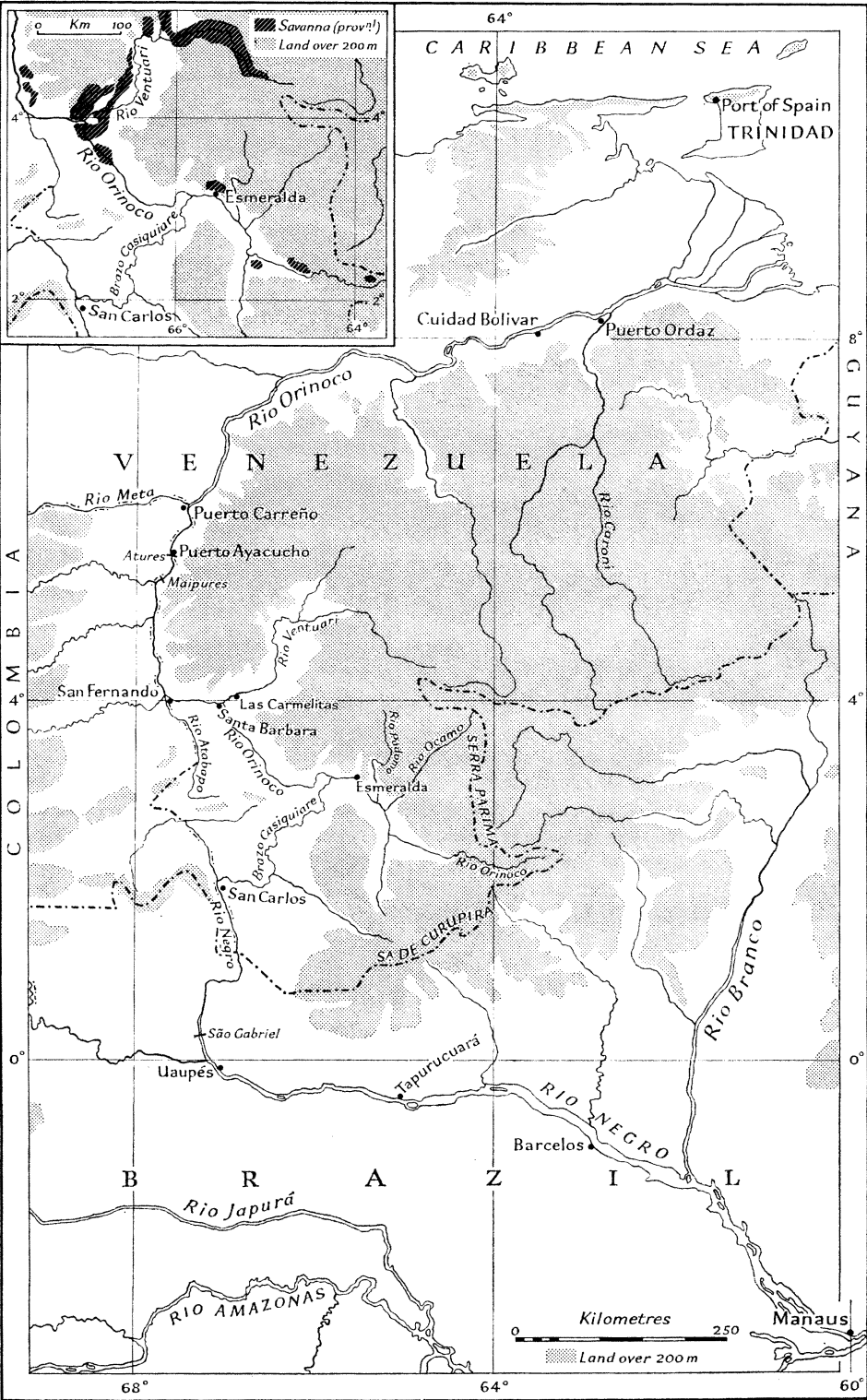


Fig. 1

record of the expedition was to be made. Preparation of the expedition commenced in England in the latter part of 1967, and in April 1968 a party of 18 people assembled in Manaus. The SR.N6 hovercraft, having made a preliminary excursion on the Rio Amazon, was prepared for departure under the command of Graham Clarke. The craft, normally a 38-seater, had been modified to accommodate expedition personnel and equipment. Anticipated cruising speeds during the journey were 30–40 knots, giving a range with supplementary fuel tanks of some 400 km. Fuel dumps had been previously established along the route.

The upper Orinoco region

The expedition departed from Manaus on 11 April 1968, and in the succeeding five days covered a distance of 1200 km along the Rio Negro to the Brazil-Venezuela frontier. Along the river, the few larger settlements are usually associated with Catholic mission stations, as at Barcelos, Tapurucuará and Uaupés; at the latter, the final township in Brazil, the mission occupies a commanding site close to the São Gabriel rapids. These were successfully negotiated on April 15, and the expedition proceeded to the small Venezuelan township of San Carlos de Rio Negro. Northwards of San Carlos lies the Negro-Orinoco watershed zone; this is a forested lowland region some 100–120 m above sea level, with isolated hill masses rising from it. There has been local planation of the interfluvial zone, and it is across this surface that the Casiquiare link is established. To the north and east of this lowland, the land forming the upper basin of the Rio Orinoco becomes more mountainous.

The region as a whole is little explored and sparsely populated; northwards of San Carlos, a river distance of 700 km separates that settlement from the next township of San Fernando de Atabapo. The region, consisting of three *departamentos* of Territorio Federal Amazonas, covers an area of 135,200 km² and had in 1961 a recorded population of only 4295 persons. An estimated 22,000 forest Indians also inhabit the area. The latter are mostly of the Yanoama tribe in the Orinoco head-water region, while smaller groups of Makiritare, Puinave and Baré-Baniva are found in the lowlands to the west (Layrisse and Wilbert, 1966). Most of this population follows a subsistence way of life, dependent on hunting, fishing, gathering, and shifting cultivation.

In spite of the inaccessibility of the region, a degree of European contact has been maintained with the area since Colonial times. During the seventeenth century, slave traders and missionaries entered the upper Rio Negro from the south, and as early as 1641 Padre Acuña referred to the existence of the Casiquiare canal. Its course remained in doubt, however, until 1744 when Padre Román travelled by river from the Orinoco to Belem on the Amazon; shortly afterwards, Spanish settlements were established from the north at San Fernando de Atabapo (1756), Esmeralda (1759) and San Carlos de Rio Negro (1760). The nineteenth century saw continuing efforts at settlement, but only towards the end of that century did the attraction of wild rubber lead to a significant influx of people. Even this phase was short-lived, however, and San Fernando, which contained 1000 people in the early twentieth century, was described in 1932 as 'a ruined skeleton of a village' with a population of some 60 people (Hanson, 1933). Although the populations of San Carlos and San Fernando have increased in recent years, to 474 and 898 respectively in 1961, the disruptive effect of European contact with the forest Indians is still evident. This is particularly so in the western lowlands, where European contact was concentrated along the Casiquiare zone and the Negro-Atabapo portage route; here only remnants of the Puinave and Baré-Baniva tribes have survived the warfare and disease

which accompanied the Europeans. Less disturbance is apparent in the more isolated headwaters of the Rio Orinoco, where Catholic and, more recently, Protestant New Tribes missionaries have had a less destructive effect on the Yanoama.

From April 19–28, the expedition worked in this region from a base camp at Esmeralda. From here one party travelled up the Rio Orinoco to undertake ethnobotanical studies among the Yanoama Indians on the Rio Ocamo, and a second party visited the Rio Padamo (Branston, 1970). Other scientists pursued geographical and ecological studies in the Casiquiare zone and around Esmeralda. On April 28 the expedition departed from Esmeralda and travelled down the Rio Orinoco to its junction with the Rio Ventuari; one party remained there at Santa Barbara, while the main expedition travelled up the Rio Ventuari to Las Carmelitas. From both camps field-work continued until May 2, when the expedition re-assembled at San Fernando de Atabapo.

The scientific programme of the expedition had been largely completed by this time, and it was the intention to cover the remaining 1350 km of the Rio Orinoco without undue delay in order to reach Port of Spain, Trinidad, on May 9. This required the successful passage of the Atures and Maipures rapids which commence below San Fernando. These severe rapids are in two main stretches, each extending intermittently over a distance of some 10 km. The rapids were reconnoitred from a Venezuelan military helicopter prior to attempting a passage. From the air they present a truly formidable sight. For long stretches the river is constantly obstructed by rocks, small islands and furiously foaming waters; there are many passages but none free of repeated hazard. On May 3, Graham Clarke successfully navigated the hovercraft down this stretch of river to the settlement of Puerto Ayacucho (Botting, 1968). Three days later, the expedition commenced the final phase of the journey, as the hovercraft set out on the broader and more placid waters of the lower Orinoco. A brief night stop was made at the Colombian frontier town of Puerto Carreño, and on the following day a distance of 600 km was covered to Ciudad Bolívar; thence we journeyed to Puerto Ordaz, and finally on May 9 the sea journey to Port of Spain, Trinidad, brought the expedition to its conclusion.

Field studies in the upper Orinoco region

(a) *Hydrological studies.*—A characteristic observed by early explorers in Amazonia is the colour contrast that exists between the waters of different streams. The Rio Negro has indeed a black appearance, while the main stream of the Rio Amazon is a 'white water' river of pale and turbid character. In the Amazon basin, Sioli (1967) has discussed these contrasts, and attributes them to differences in the sediment and solution characteristics of the respective streams. During the expedition, Dr. John Thornes of the London School of Economics continued these studies in southern Venezuela, where he undertook a programme of water and sediment sampling. Sioli has indicated that the 'white water' rivers in Brazilian Amazonas have their sources in mountainous regions, either in the Andes or in the ranges along the northern Brazilian frontier. Thence recently-derived sediments are carried into rivers, giving them their turbid appearance. In contrast, 'black water' rivers such as the Rio Negro originate in areas of low relief where extensive deposits of bleached alluvial sands are encountered. Here minimal mineral sediments and solutes are taken up by the streams and the alluvial sands, carrying humic podzol soils, yield organic substances to the groundwaters which darken the rivers. An intermediate category is also identified by Sioli (1967), consisting of 'clear water' rivers. These originate in areas of low relief, but lack the distinctive source area characteristics, and hence organic coloration, of their 'black water' counterparts.

Similar conditions were encountered by John Thornes in southern Venezuela. In general, all rivers in this region have acid waters, and display a low concentration of dissolved solids. These characteristics are most pronounced in 'black water' rivers such as the Rio Atabapo which originate in low-lying areas; here more acid waters are encountered (pH 4.3–5.6) and cation concentrations are lower than in other rivers. In contrast, the Rio Orinoco is more akin to Sioli's 'clear water' type, although in its headwater zone draining the Parima and Curupira mountains, the river shows only mild acidity (pH 5.7–6.8) and a generally higher cation concentration than elsewhere, so that it approaches in character more closely to the turbid Rio Amazon (Edwards and Thornes, 1970). In spite of these variations, however, the dissolved sediment load of all the streams examined remains low when compared with many other river waters, and contrasts with the high rates of chemical denudation in the region; the apparent discrepancy between the dissolved sediment load and rates of chemical denudation is explained, following Douglas (1969), in terms of the higher precipitation and run-off of tropical areas (Edwards and Thornes, 1970).

(b) *Vegetation studies.*—The vegetation of southern Venezuela is predominantly rain-forest or semi-deciduous forest, but may be locally replaced by savanna or herbaceous swamp. Studies of these formations are few, but valuable general descriptions have been made by early explorers such as Humboldt (1816), Wallace (1889) and Spruce (1908). More detailed investigations of the Esmeralda savanna have been undertaken by Gleason (1931). During the expedition, studies relating to the nature and origin of the savanna areas were undertaken by the author, while Dr David Harris of University College, London examined the related problem of shifting cultivation in forest areas. The savannas of southern Venezuela occupy a number of discrete zones within the forest. Floristically, the savannas are related to each other, and also to tracts of savanna elsewhere in tropical South America. In southern Venezuela, they are commonly located on low or undulating surfaces along the main riparian zones, and are associated with soils of both alluvial and residual origin. In general, the savannas are considered to be natural (Sarmiento and Monasterio, 1969) or fire-derived formations (Sauer, 1959). The present study suggests that the savannas are not a natural response to contemporary environmental conditions. They occur in humid areas, with an annual rainfall of 2000–3000 mm, and although a degree of seasonality may exist, it is neither prolonged nor severe. Nor is it possible to associate the savannas with peculiarly adverse soil conditions; thus, although the savanna soils at Esmeralda and Santa Barbara are highly weathered and infertile, so also are adjacent forest soils. Under these conditions, it is difficult to attribute the existence of savanna purely to prevailing climatic or edaphic factors.

The effect of human interference on the vegetation was investigated, particularly that of man-made fires, which occur regularly in the savanna. Field observations suggest that such fires generally prevent the advance of forest species into the savanna, but there is little evidence to indicate that burning destroys the existing forest and increases the extent of savanna. Even in areas of shifting cultivation no evidence of extensive, permanent deforestation is apparent. Shifting or 'swidden' cultivation is widely practised in southern Venezuela. It normally involves the clearance of individual plots within the forest, their use for periods varying from 2–6 years and their subsequent abandonment as soil fertility declines and weed invasion and forest regeneration take place (Harris, 1968, 1971a). In the upper Orinoco area, where population densities are very low, this system of cultivation does not appear to result in permanent deforestation. For instance, Harris indicates

that the local polycultural system of planting root and other vegetatively-reproduced crops results in the maintenance of an almost closed canopy over the soil which minimizes the opportunities for soil erosion. Soil protection is also enhanced by the perennial growth of crops and the absence of a seasonal harvest, so that the only time the soil is bared is immediately after clearance. Under these conditions, site deterioration is unlikely to be great during periods of cultivation, and forest regeneration may normally be expected to occur. Even the likelihood of fire interrupting the regeneration cycle in individual plots, and establishing a deflected succession to savanna, is minimized in the humid environment of southern Venezuela where invasion of abandoned plots by shrubs and trees occurs rapidly (Harris, 1971a).

The cycle of cultivation and regeneration appears likely to break down only if the density of cultivation is greatly increased, and the periods of forest fallow are shortened (Harris, 1971b). There is currently little evidence for this in southern Venezuela, although elsewhere in the tropical American lowlands a more intensive form of agriculture probably existed in pre-Columbian times (Denevan, 1966; Parsons and Denevan, 1967). The latter, however, appears to have been localized on the flood-plain of the Rio Amazon and on similar sites where recently derived sediments of Andean origin give rise to more fertile soils. Comparable conditions, however, have not been encountered in southern Venezuela, where not only do the soils of black water zones appear to be infertile, but even at sites along the turbid Orinoco, alluvial and other soils are found to be acid and nutrient deficient. In general, therefore, some doubt may be cast on the assumption in southern Venezuela that human interference has significantly modified the savanna-forest distribution.

Other influences such as changes in climate, however, may be more significant. In this context, Eden (1964), Fittkau (1969) and others have suggested that Pleistocene climatic fluctuations in tropical America may have induced considerable changes in the distribution of savanna and forest. If this has been the case, the possibility also exists that some areas of savanna may be relics of an earlier, more extensive savanna cover, which has persisted locally to the present, perhaps as a result of burning, against a natural tendency to reforestation. This hypothesis would explain the occurrence of discrete but floristically related tracts of savanna in southern Venezuela, and it accords with the suggestion of Ducke and Black (1953) that many isolated savannas in Brazilian Amazonas are floristically related to each other, and are 'formations probably older than the rain forest'. Also the hypothesis could account for the existence of savanna in a high rainfall region such as southern Venezuela which, under natural conditions, might be expected to support a forest climax. That this is not invariably so is partly due to the effects of burning, which in general appear to maintain existing savanna against forest invasion (Eden, 1966). The origin of the savanna, as distinct from its maintenance, however, is less easily explained in these terms, and in southern Venezuela the savanna may be a fire-maintained relic of an earlier more extensive distribution, probably associated with a period of drier climatic conditions.

(c) *Ethnobotanical studies*.—In many respects the material culture of the forest Indians of tropical South America is primitive in character, although it involves sophisticated exploitation of some environmental resources: hunting and fishing activities, for example, are facilitated by the use of complex, naturally derived poisons which are prepared by the Indians. Of these, *curare* used for tipping hunting arrows and darts is perhaps the best known, but many other poisons are also manufactured. In addition, complex medicinal and narcotic substances are prepared and utilized. Knowledge of such preparations has already been of value to Western

society, and *curare* in particular has made a contribution to present day surgery (Gorinsky, 1969). Other preparations of this kind, as yet uninvestigated, may also have value to modern society. But the possibility of their investigation is diminishing, as the spread of European culture erodes traditional knowledge.

During the expedition, Conrad Gorinsky of St. Bartholomew's Hospital Medical College, London, investigated such materials, and in particular sought to obtain detailed information on the plant sources and methods of preparation of the trance-inducing narcotic, *yopo*, manufactured and used by the Piaroa and Yanoama Indians. Preliminary botanical studies of *yopo* have been undertaken by Schultes and Holmstedt (1968), who indicated that it is derived from *Virola* sp., *Piptadenia* sp. and other forest plants, but as yet the chemistry of the preparation is incompletely investigated. During the expedition, Gorinsky visited Indian settlements on the Ocamo and Ventuari rivers, where plant materials and samples of *yopo* were obtained, together with a striking demonstration of the drug's potency under native usage (Gorinsky, 1969). At present, chemical investigations of the materials collected are not complete, but it is hoped that the preparations, although of less obvious benefit to the Indians themselves, may yield information in the laboratory of value from a medical point of view.

Acknowledgements

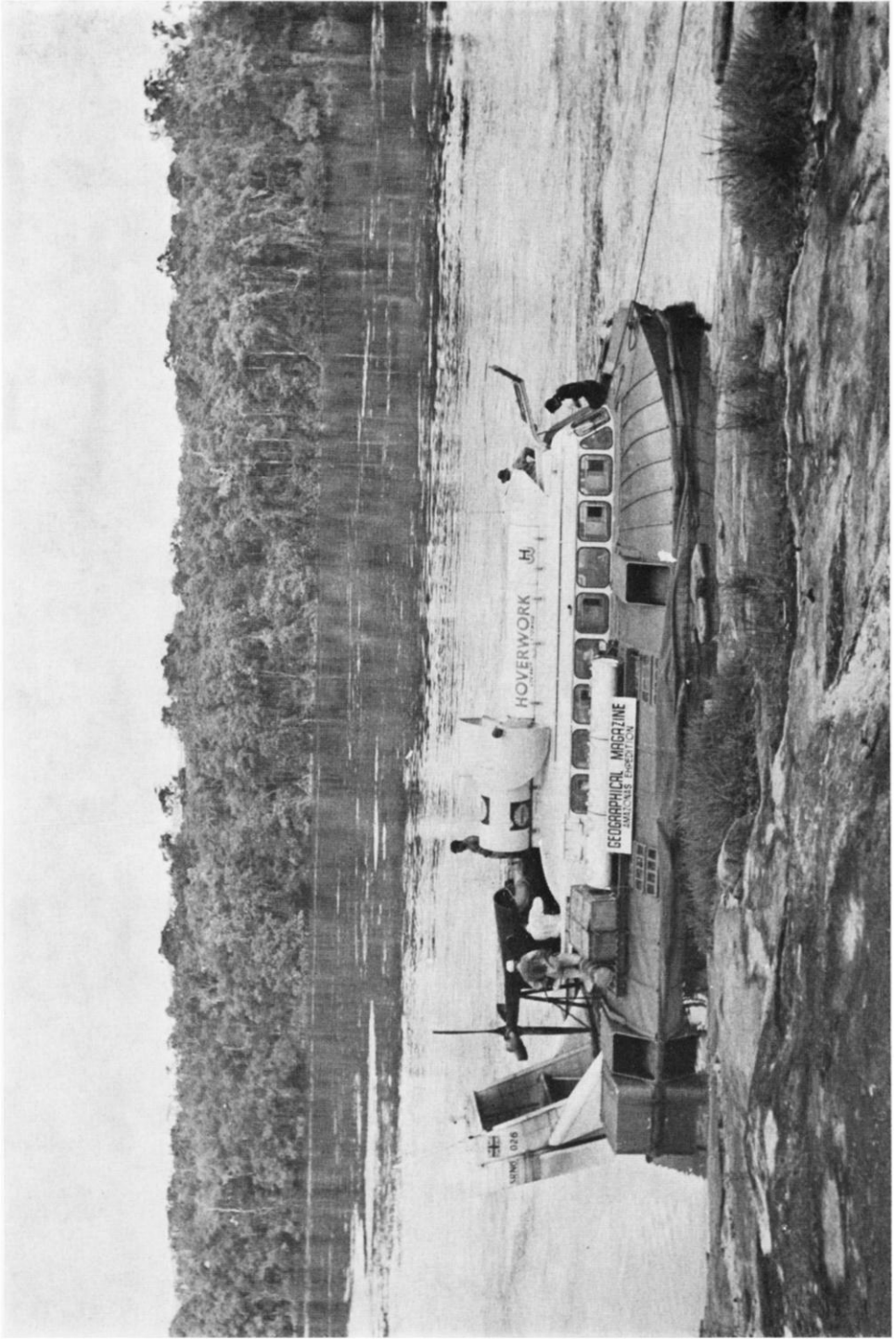
The writer thanks Derek Weber, Editor of the *Geographical Magazine*, who initiated and directed the expedition, and the Royal Geographical Society and Ministry of Technology which gave it their support. Thanks are also due to my scientific colleagues and other expedition members who contributed to the success of the venture; also to the Natural Environment Research Council which provided financial support for research assistance and laboratory analyses.

References

- Botting, D. 1968 Journey of hovercraft 'el fantástico'. *Geogr. Mag. Lond.* **41**, 97-106.
- Branston, B. 1970 *The last great journey on earth*. Hodder and Stoughton.
- Denevan, W. M. 1966 A cultural-ecological view of the former aboriginal settlement in the Amazon basin. *Prof. Geogr.* **18**, 346-51.
- Douglas, I. 1969 The efficiency of humid tropical denudation systems. *Trans. Inst. Br. Geogr.* **46**, 1-16.
- Ducke, A., and G. A. Black 1953 Phytogeographical notes on the Brazilian Amazon. *An. Acad. bras. Cienc.* **25**, 1-46.
- Eden, M. J. 1964 The savanna ecosystem; northern Rupununi, British Guiana. *McGill Univ. Savanna Res. Ser.* **1**.
- 1966 The effect of changing fire conditions on the vegetation of the Estacion Biologica de los Llanos, Calabozo. *Boln. Soc. venez. Cienc. nat.* **27**, 104-13.
- Edwards, A. M. C., and J. B. Thornes 1970 Observations on the dissolved solids of the Casiquiare and upper Orinoco, April-June 1968. *Amazoniana* **2**, 245-56.
- Fittkau, E. J. 1969 The fauna of South America in Fittkau, E. J. et al. *Biogeography and ecology in South America* **2**. The Hague: Dr. W. Junk.
- Gleason, H. A. 1931 Botanical results of the Tyler-Duida Expedition. *Bull. Torrey bot. Club* **58**, 277-506.
- Gorinsky, C. 1969 Amazonas—a study in neglect. *Geogr. Mag. Lond.* **41**, 308-12.
- Hanson, E. 1933 Social regression in the Orinoco and Amazon basins. *Geogr. Rev.* **23**, 578-98.
- Harris, D. R. 1968 Venezuela's empty rain forests. *Geogr. Mag. Lond.* **41**, 216-20.
- 1971a The ecology of swidden cultivation in the upper Orinoco rain forest, Venezuela. *Geogr. Rev.* **61**, in press.
- 1971b Swidden systems and settlement in P. J. Ucko, R. Tringham, and G. W. Dimbleby, *Settlement Patterns and Urbanisation*. Duckworth.
- Humboldt, A. von. 1816 *Voyages aux régions équinoxiales du nouveau continent fait dans les années 1799 à 1804*. Paris.

- Layrisse, M. and J. Wilbert, 1966 *Indian societies of Venezuela*. Caracas: Fundacion La Salle.
- Parsons, J. J., and W. M. Denevan, 1967 Pre-Colombian ridged fields. *Scient. Am.* **217**, 93-100.
- Sarmiento, G. and M. Monasterio, 1969 Studies on the savanna vegetation of the Venezuelan Llanos. *J. Ecol.* **57**, 579-98.
- Sauer, C. O. 1959 Man in the ecology of tropical America. *Proc. 9th Pacif. Sci. Congr.* **20**, 104-10.
- Schultes, R. E., and B. Holmstedt 1968 De plantis toxicariis e mundo novo tropicale commentationes. *Rhodora* **70**, 113-60.
- Sioli, H. 1967 Studies in Amazonian waters. *Atas Simp. Biota Amazon*, **3**, 9-50.
- Spruce, R. 1908 *Notes of a botanist on the Amazon and Andes*.
- Wallace, A. R. 1889 *Travels on the Amazon and Rio Negro*.

PLATE I



Routine maintenance of the SR.N6 hovercraft in the Casiquiare canal, southern Venezuela

See pp 149-56